

BACK

□ VERTEBRAE

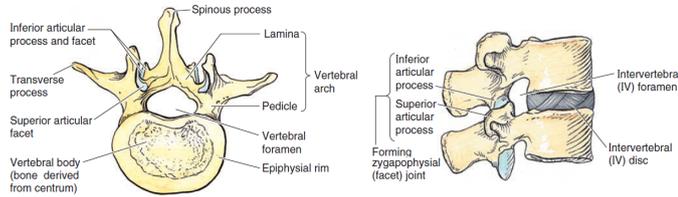
STRUCTURE & FUNCTION

Part	Subdivisions	Noteworthy
Body	Trabeculae with active red marrow and thin layer of compact bone ¹ (Basivertebral veins drain marrow)	
V. Arch	Pedicles x2 Lamina x2	Form borders of vertebral foramen
Processes	Spinous Transverse x2 Articular x4 ³	Forms borders of IV foramen (exit of ganglia)

C	5
T	12
L	5
S	5 ¹
C	4 ²
Total	33

¹Fused
²Fused when 30yrs

¹Epiphyseal Rim | ²Closest to Body | ³Sup x2, Inf x2



REGIONAL CHARACTERISTICS

Cervical

- Greatest movement due to
 - Comparatively large IV discs & Wider body ratio
 - **Horizontal articular facets** (sup facet supero-posterior)
 - Small amount of surrounding body mass,
- All have foramen in TP ie **foramen transversaria** (carry vert a., v., symph plexus)
- C7 spinous process prominent

Atypical Vertebrae

C1 (Atlas)

- 2 **lateral masses** (not 1 body)
- 2 arches (ant/post) which join lateral masses
- Post arch has groove for vertebral artery (and nerve) on superior surface
- TP off lateral body ∴ widest c-spine (good for leverage)
- Articulate with **occipital epicondyles**

C2 (Axis)

- Head rotation occurs on C1-2
- Strongest c-spine
- **Dens** projects superiorly from body (held to atlas by transverse ligament)
- Superior articular facet on body (not TP)
- Bifid SP (also C3-6)

Thoracic

- **Costal facets** x3 (sup & inf on body and one on TP)
- **Vertical articular facet** → movement through arc here allows rotation and some flexion
NB Sup facet post-lat
- T1-4 has horizontal SP, complete costal facet on sup edge of body & demifacet inf for 2nd rib
- T5-8 are "typical"
- T9-12 (T12 has most transition to be like L-spine)
 - T12 sup ½ like thoracic vert eg flex/ext/rotate
 - T12 inf ½ like lumbar eg no costal facets or extensions

Lumbar

- Massive bodies
- **Vertical articular facet** (Sup facet post-lat)
- Post base of TP has accessory process → **intertransversarii**
- Post surface Sup articular process → **multifidus & intertransversarii**

Sacrum

- **Sacral canal** is cont of **vertebral canal** (houses **terminal cauda**)
- 4 pairs of sacral foramina
- L5-S1 = lumbosacral angle = 130-160 degrees
- **Median sacral crest** posteriorly represents fused SP
- **Intermediate sacral crest** = fused AP
- **Lateral crest** = fused TP
- **Sacral hiatus** = space due to lack of S5 lamina or SP
- **Sacral cornua** = S5 articular process (either side of hiatus)

Coccyx

- C1 not fused to C2-4 until 20's
- S5 fused to C1-4 later in life
- Non WB (except when sitting)

Ossification

Ossification	Primary (8 weeks)	Secondary (Puberty)
Typical	3 primary centres Centrum → body Perichondral x2 → arches	5 secondary centres Tip of SP, TP x2, Superior/inferior annular epiphyses Annular epiphyses → epiphyseal rim in adulthood
C1	Arch x2	Lamina x2, apex
C2	Centrum x2	Lamina x2, SP

NB C7, sacrum, coccyx also different

Variations in Vertebrae

- When variations exist: More vert in male / Less vertebrae in women (Total approx. 5-12%)
- C-spine constant

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□ VERTEBRAL COLUMN

JOINTS

- **Vertebral bodies**
- **Vertebral arches**
- **Craniovertebral**
- **Costovertebral** (Discussed in thorax)
- **Sacroiliac** (discussed in pelvis)

Vertebral Bodies

- No IV @ C1/2 or below L5/S1

Type	2ry cartilaginous
Movements	Flex/Ext/Lat Flex/Rotation
Articular Surfaces	IV disc made of peripheral annulus fibrosus and central nucleus pulposus <ul style="list-style-type: none"> • Annulus attaches to epiphyseal rings and has oblique ligaments (limits rotation) • Only outer 1/3 sensory
Ligaments	Ant longitudinal ligament : pelvic surface of sacrum → ant tubercle C1/occipital bone Post longitudinal ligament : thinner, in canal, attachment to IV disc (weakly to body) C2 → sacrum

Vertebral Arch

Type	Plane synovial, Facet joints (zygapophysial)
Movements	Gliding
Articular Surfaces	Sup → Inf articular processes
Ligaments	<ul style="list-style-type: none"> • Ligament flava: lamina to lamina • Supraspinous ligament: tips SP, C7 → sacrum (strong) • Infraspinoous ligament: root to apex (weak) • Nuchal ligament: occiput/foramen magnum → down SP tips • Intertransverse ligament: TP from diff vert

Craniovertebral

Atlanto-occipital

Type	Synovial (thin capsule)
Movements	Flex/ext (some lat flexion/rotation)
Articular Surfaces	Atlas to occipital condyles
Ligaments	Atlanto-occipital membrane (ant/post) foramen magnum → atlas arches

Atlanto-axial

Type	?
Movements	Facet = glide Median = pivot Together allow rotation of [cranium/C1] on C2
Articular Surfaces	Facet x2 median x1 (dens → arch)
Ligaments	<ul style="list-style-type: none"> • Transverse ligament: holds dens to arch of C1 • Longitudinal bands: occiput → transverse ligament → C2 body } Cruciate ligament • Alar ligaments: lat dens → foramen magnum (prevent excess rotation) • Tectorial membrane: cont/thickening of post long lig → floor of cranium

MOVEMENTS

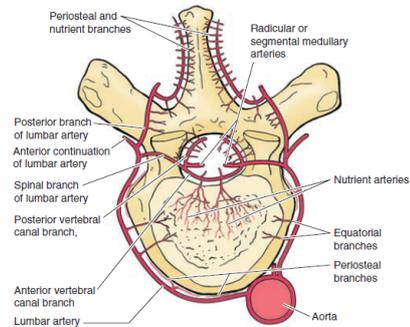
- Flex/ext/lat flex/lat ext/rotation
- Limited by angle of facet jts, ligaments, abdominal muscles, thoracic cage
- **Flexion greatest in c-spine**
- **Extension greatest in l-spine** (minimal rotation)
- Lateral flexion good in c and L spine

CURVATURES

- Primary curvature: Thoracic & sacral kyphosis (concave ant)
- Secondary curvature: Cervical & lumbar lordoses

VASCULATURE

- Segmental arteries origin differ depending on level
 - Neck: vertebral & cervical ascending
 - Thoracic: post intercostal a.
 - Abdomen: subcostal & lumbar a.
 - Pelvis: Iliolumbar @ lateral and medial sacral a.
- Branch anteriorly and course post-lat around the body, giving off **Periosteal, equatorial a.**
- Branch through IV foramina as **ant/post vertebral canal, terminal radicular** within canal
 - Both give off asc/desc branches that anastomose along canal
 - **Ant vert canal branch** supplies red marrow
- Terminate as **post branch of lumbar a.**



Veins

- **Internal & external venous plexus** drain into vertebral and segmental veins of trunk

NERVES

- Recurrent meningeal branch of spinal nerve
- Arise just after ant/post rami split (recurrent as backtracks through IV foramina)

BACK

MUSCLES OF BACK

EXTRINSIC

Superficial

- Limb control
- Trapezius, lat dorsi, levator scapulae, rhomboids

Intermediate

- Serratus post sup & inf
- Proprioceptive resp

INTRINSIC

- Act on vertebral column
- Innervated by **post rami**
- Enclosed by deep fascia which attach to
 - Medial: nuchal/SP/supraspinous lig, median crest sacrum
 - Lateral: C & L-spine TP & angles of ribs

Superficial

Splenius			
L Capitus	Nuchal ligament	Mastoid process	Lateral flex
L Cervicus	SP C7-T3/4	C1-3/4 TP	Rotate head
			Together: extend head/neck

Intermediate

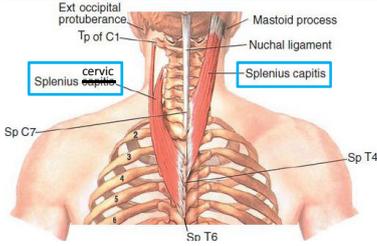
Erector Spinae			
L Iliocostalis	Broad tendon on Iliac Crest	Angle of ribs (Inf surface) & C-spine TP	Bilateral Chief Exten column & head Control movt
L Longissimus	Post sacrum Sacroiliac lig Sacral/Lumbar SP	Mastoid Ribs (btwn TP & angle)	
L Spinalis		Cranium SP in upper T-spine	Unilateral Lat flex column

Deep

Transversospinalis			
L Semispinalis	C4-T12 TP	SP 4-6 seg above incl occipital	Extend head/OC/T-spine Rotate
L Multifidus	Post Sacrum, PSIS, TP T1-3 AP C4-7	SP above spanning 2-4 segments	Stabilise during movement
L Rotatores	TP (mostly t-spine)	Brevis: SP or TP above Longus: SP or TP 2 seg above	Stabilise & assist with local ext

Deep: Weak

Interspinales	SP	SP	Aid ext/rot
Intertransversarii	TP of C & L-spine	TP adj	Aid lat flex
Levatores costarum	TP C7-T11	Rib below btwn tubercle & angle	Elevate ribs



PRINCIPLE MUSCLES OF MOVEMENT

Cervical

Flexion	Extension	Lateral Bend	Rotation
Longus Colli Scalene SSCM	Splenius Capitis, Cervicus, levator scapulae Longissimus, Iliocostalis Semispinalis, multifidus Trapezius	Iliocostalis Longissimus Splenius Intertransversarii Scalenes	Rotatores Semispinalis Multifidus Splenius Cervicus

Thoracolumbar

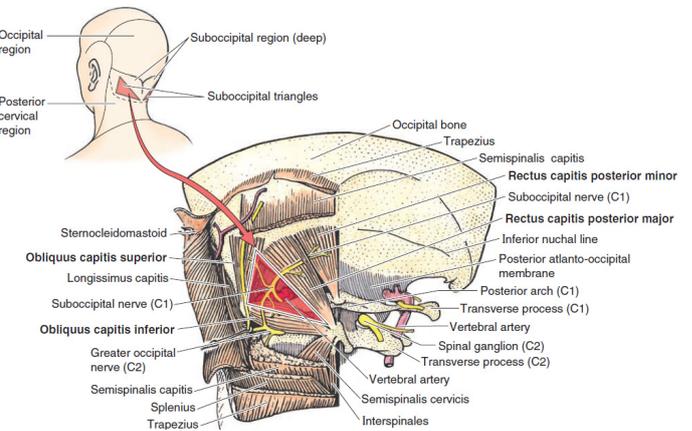
Flexion	Extension	Lateral Bend	Rotation
Rectus Abdominus Psoas major Gravity	Erector Spinae Multifidus Semispinalis thoracis	Serr Ant Rhomboids Quadratus lumborum Ext/Int Obliques Multifidus Longissimus Iliocostalis	Rotatores Multifidus Iliocostalis Longissimus Ext/Int oblique Splenius

Atlanto-occipital Joint

Flexion	Extension	Lateral Bend
Longus capitis Rectus Capitus Anterior SCM Supra/Infrahyoid	Rectus Capitus Post Obliquus capitis Splenius capitis Longissimus capitis Trapezius	SCM Obliquus capitis Rectus capitis lateralis Longissimus capitis Splenius capitis

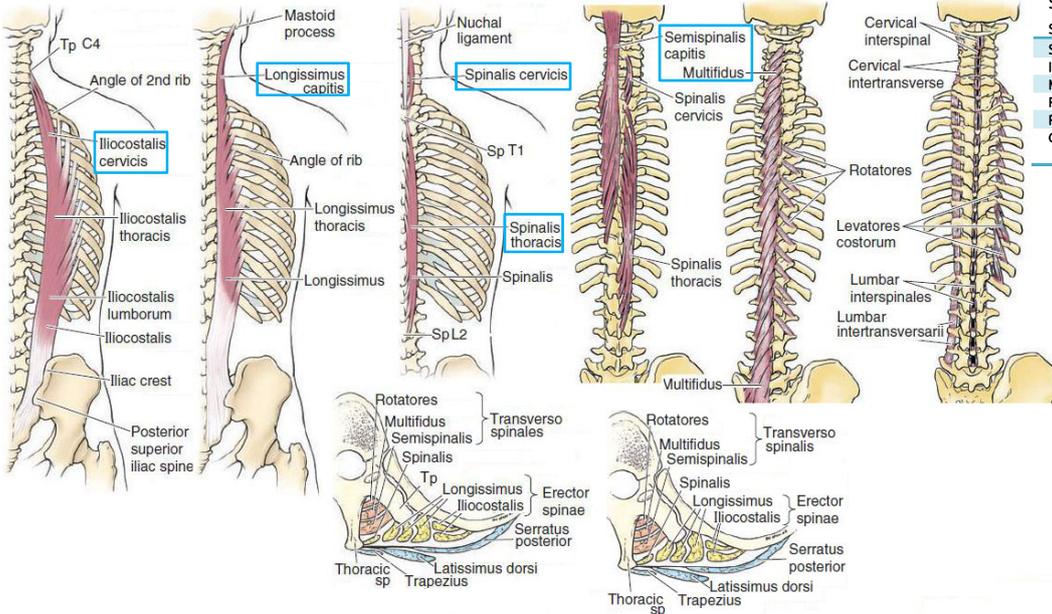
SUBOCCIPITAL DEEP NECK MUSCLES

Rectus capitis post		
L Major	C2 SP	Lateral inf nuchal line
L Minor	C1 post tubercle	Medial inf nuchal line
Obliquus capitis		
L inferior	C2 post tubercle	C1 TP
L Superior	C1 TP	Btwn inf/sup nuchal line



Sub occipital Triangle

Superomedial	RCP Major
Superolateral	OC superior
Inferolateral	OC inferior
Medial	Rectus Capitus Posterior Major
Floor	C1 arch, atlanto-occipital membrane
Roof	Semispinalis capitis/Trapezius
Contents	Vertebral artery (medial) Sub occipital nerve (lateral)



□ CONTENTS OF VERTEBRAL CANAL

SPINAL CORD

- Medulla oblongata to L1-2 (variably T12 – L3) as *conus medullaris* (filum terminale in sacral hiatus)
- Cervical enlargement (C4-T1)
- Lumbosacral enlargement (T11-S1)

SPINAL NERVE ROOTS

- *C-spine* roots named after vertebrae *superior to exit* (except C8 root above T1)
- *T/L-spine* roots named after vertebrae *inferior to exit*
- S-spine roots form rami within sacrum
- S5 goes through *sacral hiatus*

Spinal Meninges

- Unit of **[dura, arachnoid, pia]**

Dura

- **Epidural space** outside and Forms spinal dural sac
- **Venous plexus** within space
- Space extends to foramen magnum → sacral hiatus/sacrococcygeal ligament
- Forms **dural sheaths** laterally with roots that merge with **epineurium**

Arachnoid

- Encloses CSF (incl Pia)
- Follows dural sheath out
- Held against dura by CSF pressure only
- **Subdural space** is a pathological space btwn arachnoid-dura
- **Subarachnoid space** is between arachnoid-pia

Pia

- Thin, transparent
- Terminates as filum terminale
- Suspends cord through filum & lateral denticulate ligaments (pia extensions btwn ant/post roots)

Subarachnoid Space

- Lumbar cistern – expansion in lumbar region L2 – S2
- Holds CSF
- Between Subarachnoid-Pia

VASCULAR

Arterial

- 3 arteries descend full length to supply
- *Anterior spinal, posterior spinal* x2

Ant spinal

- Origin: joining of *superior vertebral arteries*
- Run inf in ant **median fissure**
- Sulcal arteries branch at all levels to infiltrate cord
- Supplies 2/3

Post Spinal

- Branch of vertebral or post-inf cerebellar
- Anastomoses in pia

NB Contributions by different vessels at different levels as well

- Vertebral, ascending cervical, deep cervical, intercostal, lumbar, lateral sacral a.
- These (as well as spinal a.) form **medullary arteries** at lumbosacral and cervical enlargement
- **Great anterior medullary artery** originates from inferior intercostal or upper lumbar artery to supply 2/3 of cord